

CHAPTER 3: THE ENHANCED E-R MODEL

Modern Database Management
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OBJECTIVES

- ✖ Define terms
- ✖ Understand use of supertype/subtype relationships
- ✖ Understand use of specialization and generalization techniques
- ✖ Specify completeness and disjointness constraints
- ✖ Develop supertype/subtype hierarchies for realistic business situations
- ✖ Develop entity clusters
- ✖ Explain universal (packaged) data model
- ✖ Describe special features of data modeling project using packaged data model

SUPERTYPES AND SUBTYPES

- ✗ **Enhanced ER model:** extends original ER model with new modeling constructs
- ✗ **Subtype:** A subgrouping of the entities in an entity type that has attributes distinct from those in other subgroupings
- ✗ **Supertype:** A generic entity type that has a relationship with one or more subtypes
- ✗ **Attribute Inheritance:**
 - + Subtype entities inherit values of all attributes of the supertype
 - + An instance of a subtype is also an instance of the supertype

Figure 3-1 Basic notation for supertype/subtype notation

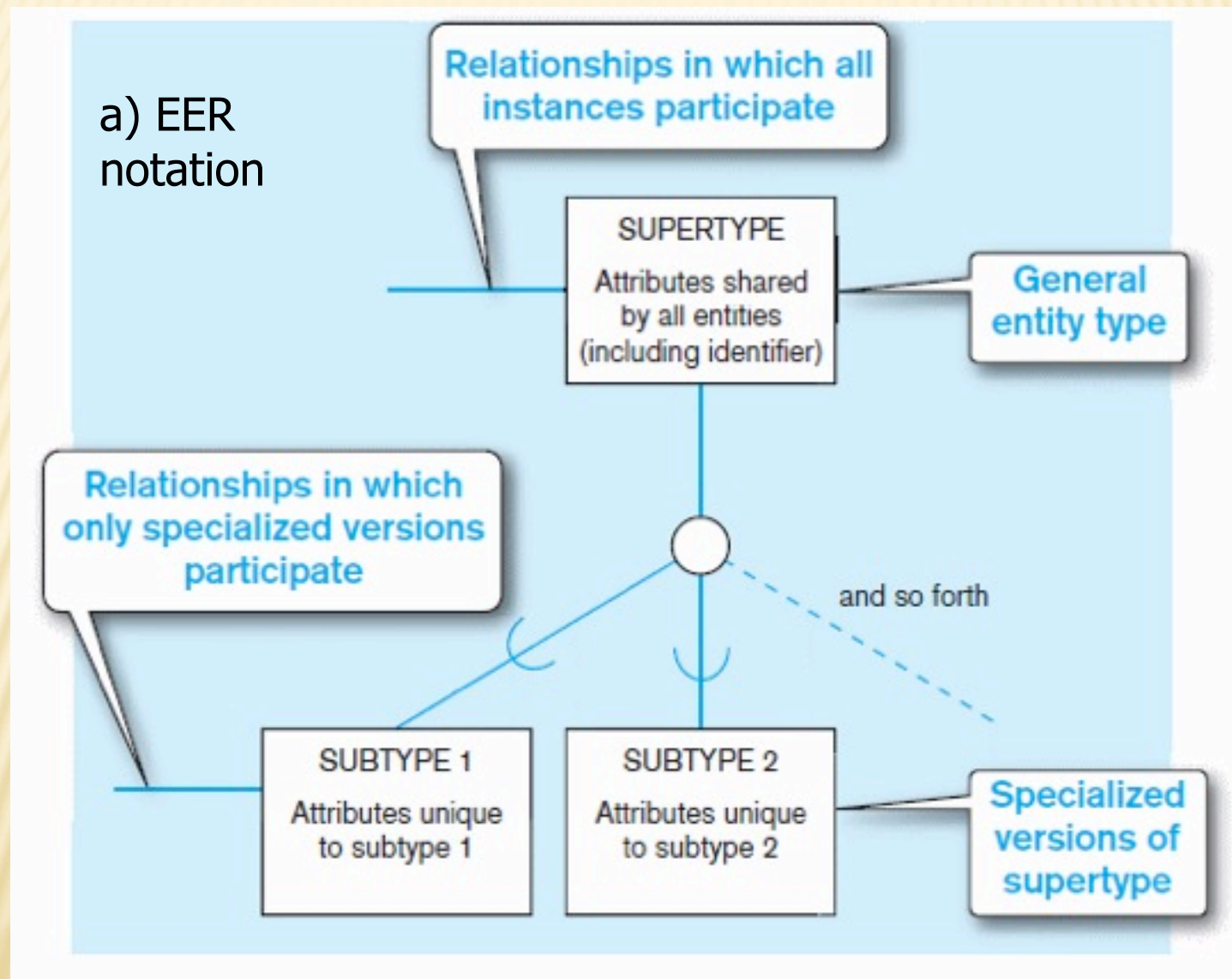
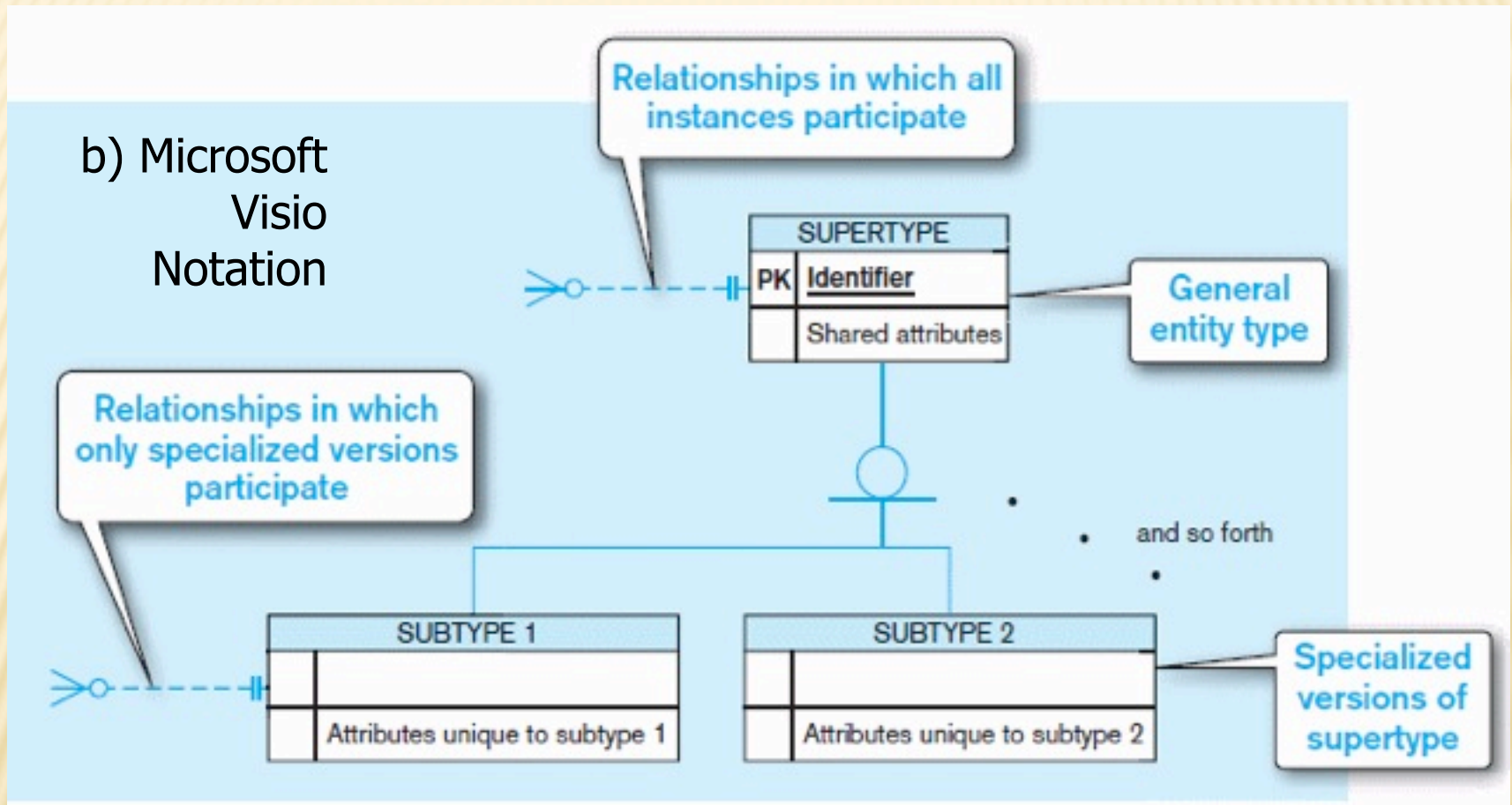
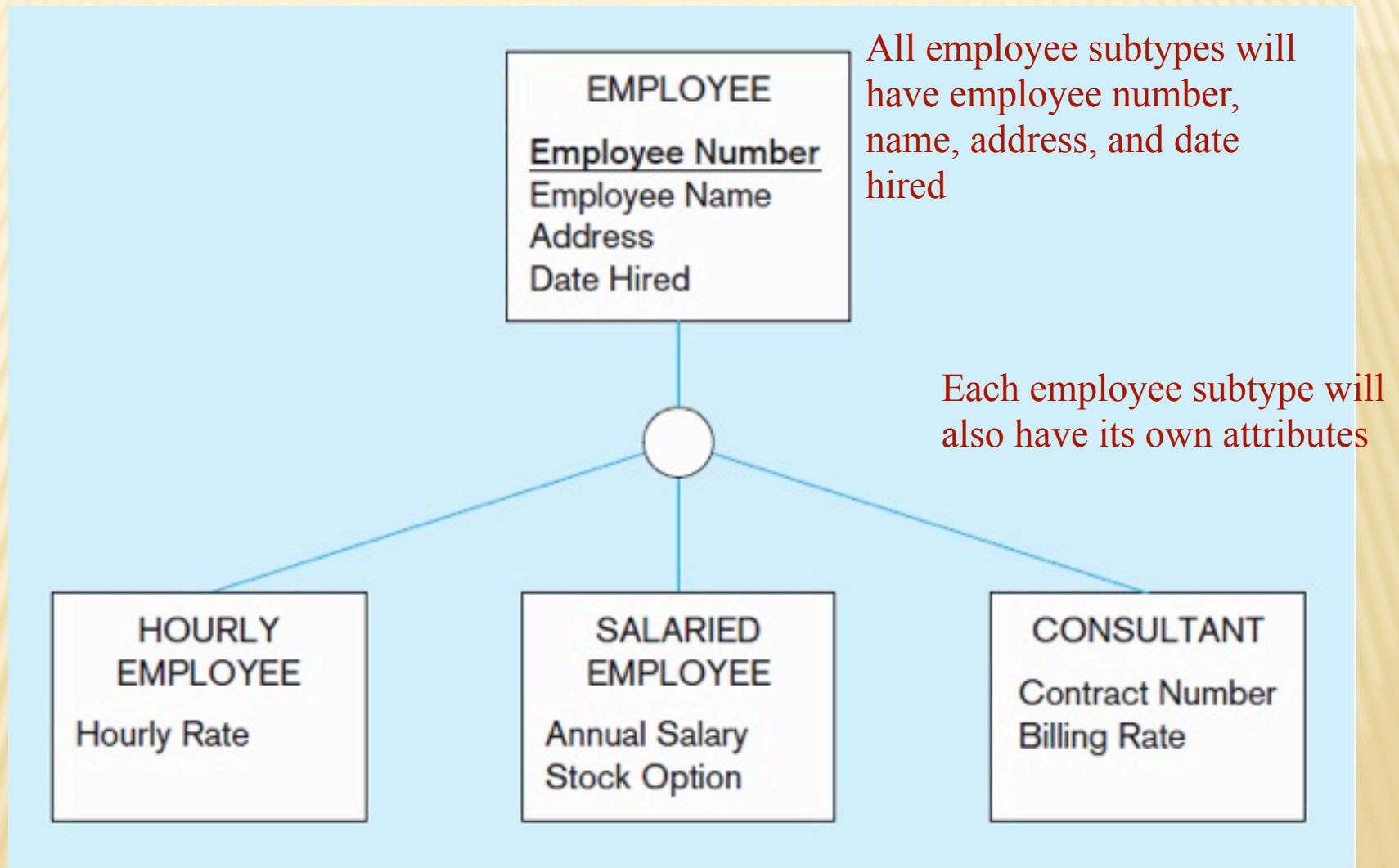


Figure 3-1 Basic notation for supertype/subtype notation (cont.)



Different modeling tools may have different notation for the same modeling constructs.

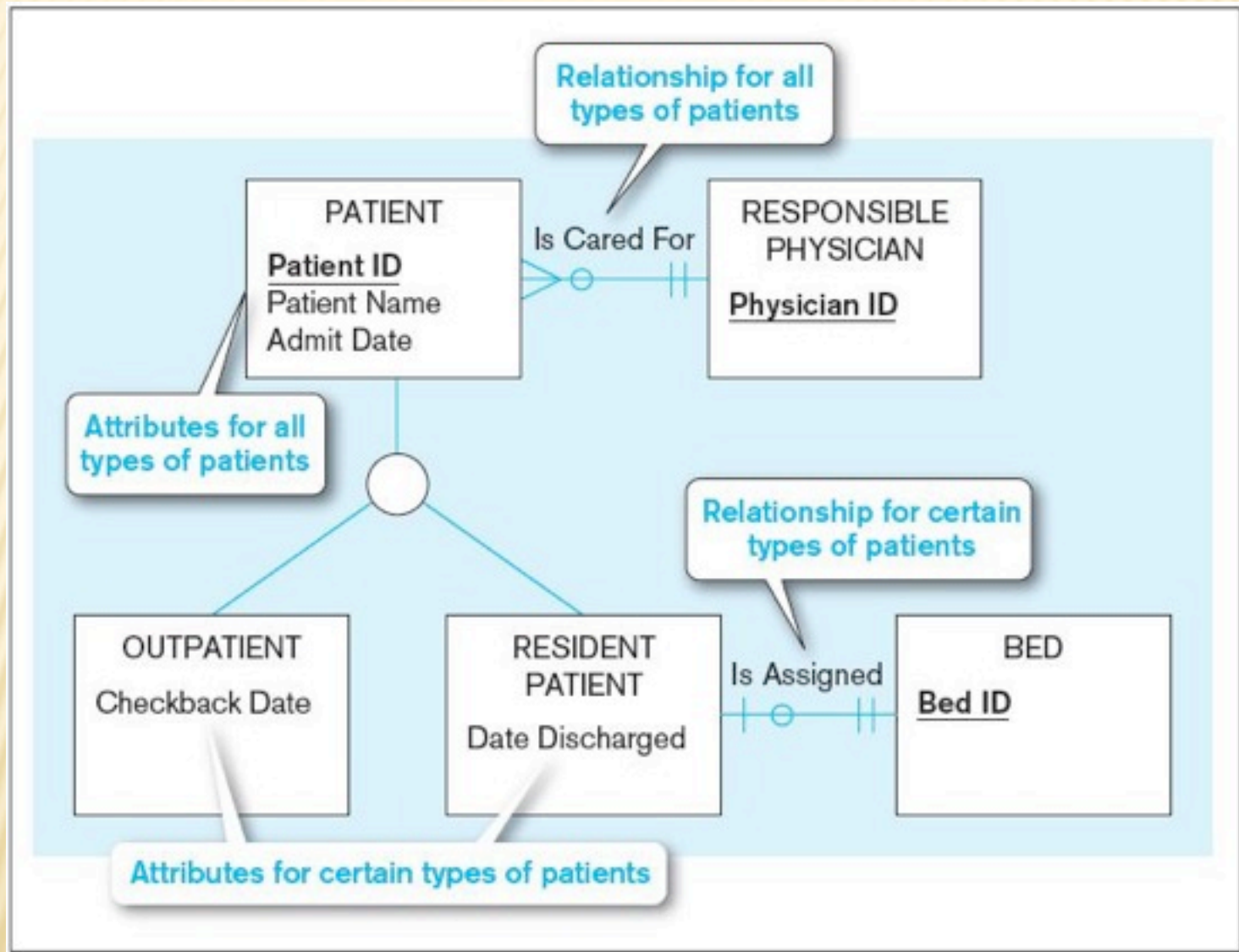
Figure 3-2 Employee supertype with three subtypes



RELATIONSHIPS AND SUBTYPES

- ✗ Relationships at the **supertype** level indicate that all subtypes will participate in the relationship
- ✗ The instances of a **subtype** may participate in a relationship unique to that subtype. In this situation, the relationship is shown at the subtype level

Figure 3-3 Supertype/subtype relationships in a hospital

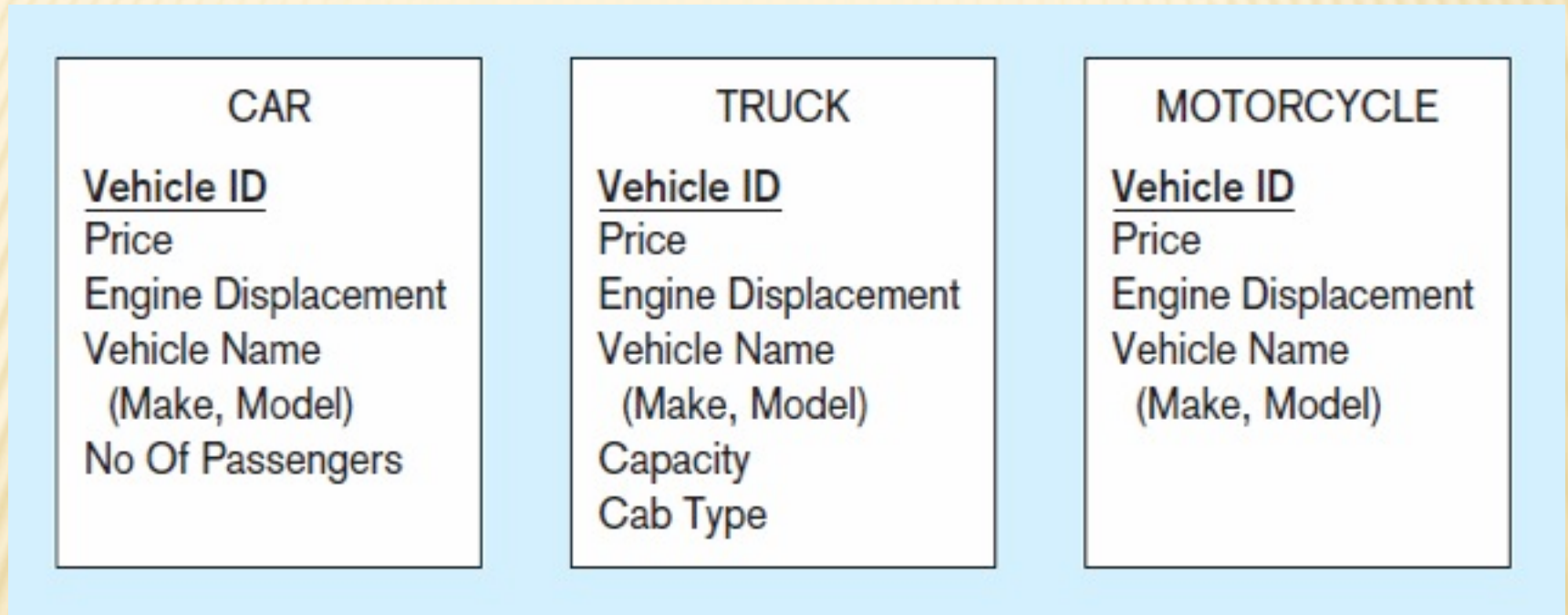


GENERALIZATION AND SPECIALIZATION

- ✖ **Generalization:** The process of defining a more general entity type from a set of more specialized entity types. BOTTOM-UP
- ✖ **Specialization:** The process of defining one or more subtypes of the supertype and forming

Figure 3-4 Example of generalization

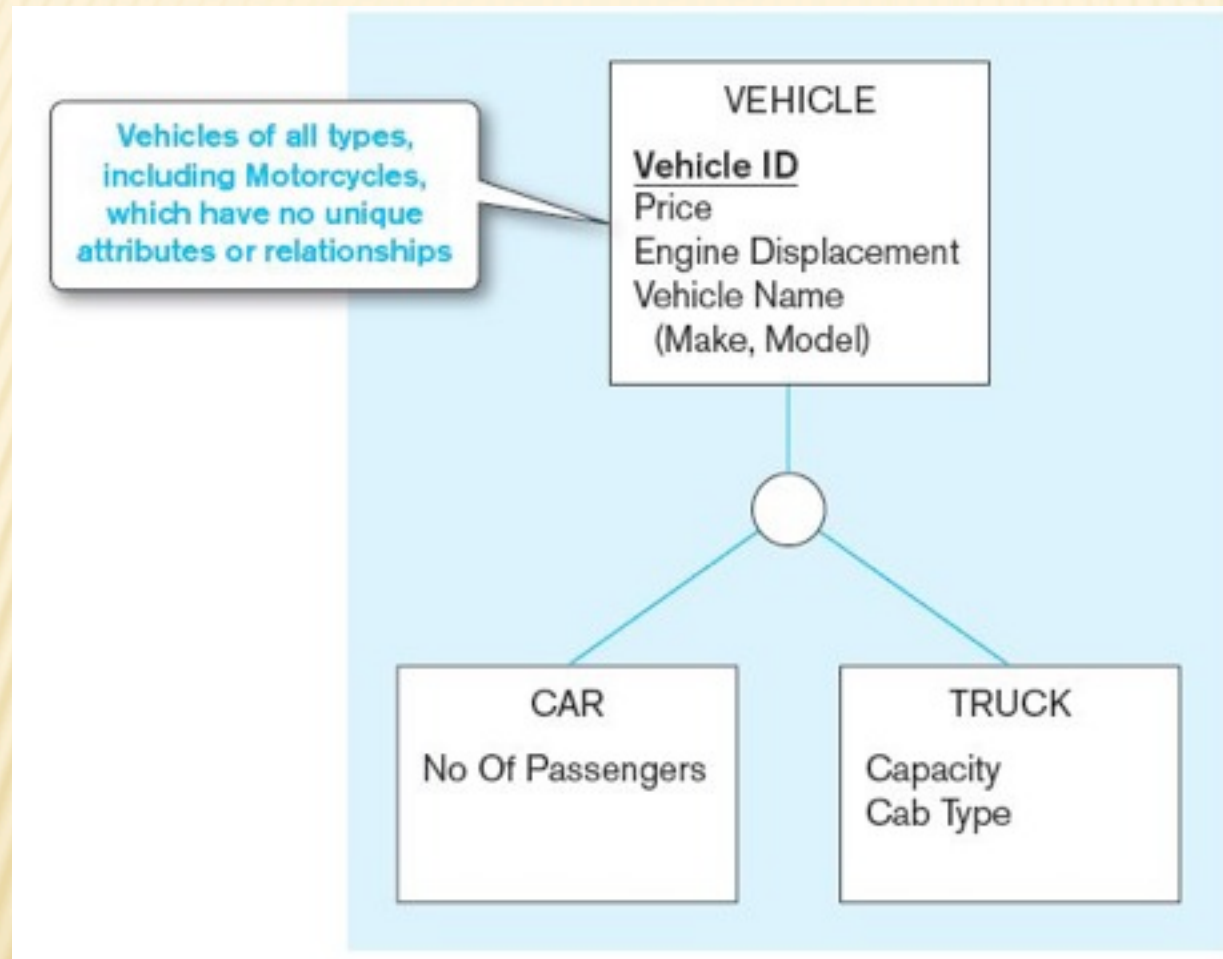
a) Three entity types: CAR, TRUCK, and MOTORCYCLE



All these types of vehicles have common attributes

Figure 3-4 Example of generalization (cont.)

b) Generalization to VEHICLE supertype

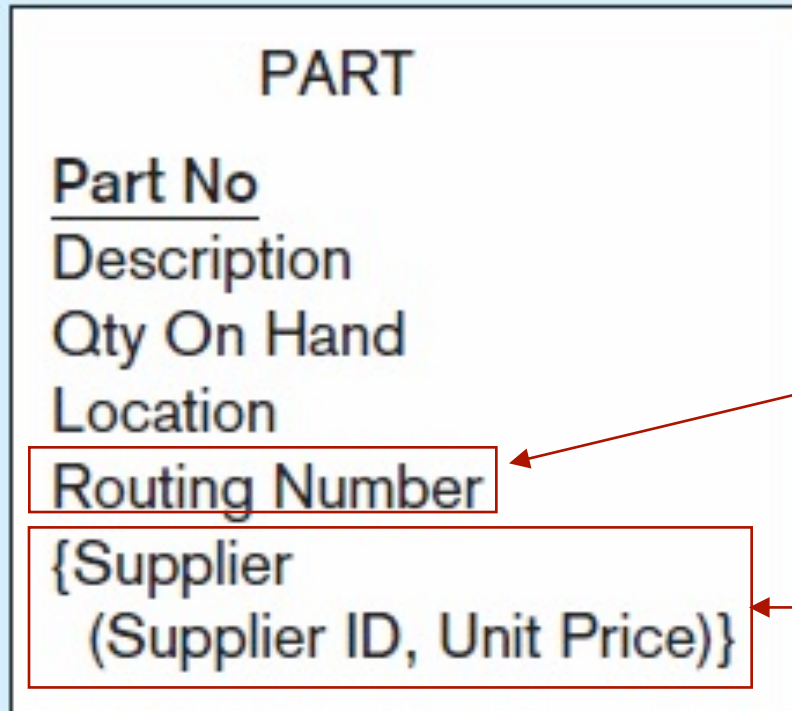


So we put the shared attributes in a supertype

Note: no subtype for motorcycle, since it has no unique attributes

Figure 3-5 Example of specialization

a) Entity type PART

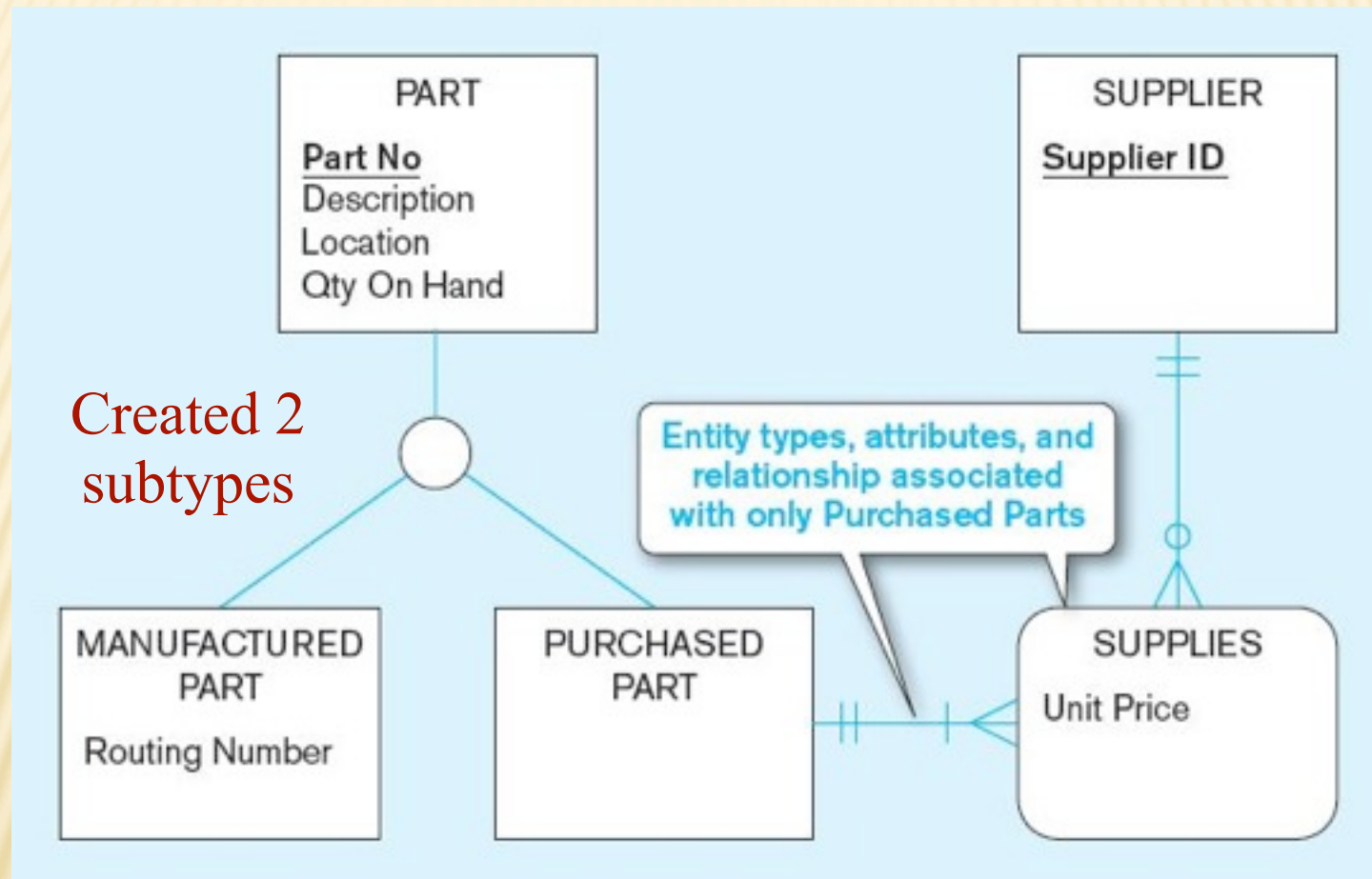


Only applies to
manufactured parts

Applies only to purchased parts

Figure 3-5 Example of specialization (cont.)

b) Specialization to MANUFACTURED PART and PURCHASED PART



Note: multivalued composite attribute was replaced by an associative entity relationship to another entity

CONSTRAINTS IN SUPERTYPE/ SUBTYPE RELATIONSHIPS

- ✖ **Completeness Constraints:**
Whether an instance of a supertype **must** also be a member of at least one subtype
 - + Total Specialization Rule: Yes (double line)
 - + Partial Specialization Rule: No (single line)

Figure 3-6 Examples of completeness constraints

a) Total specialization rule

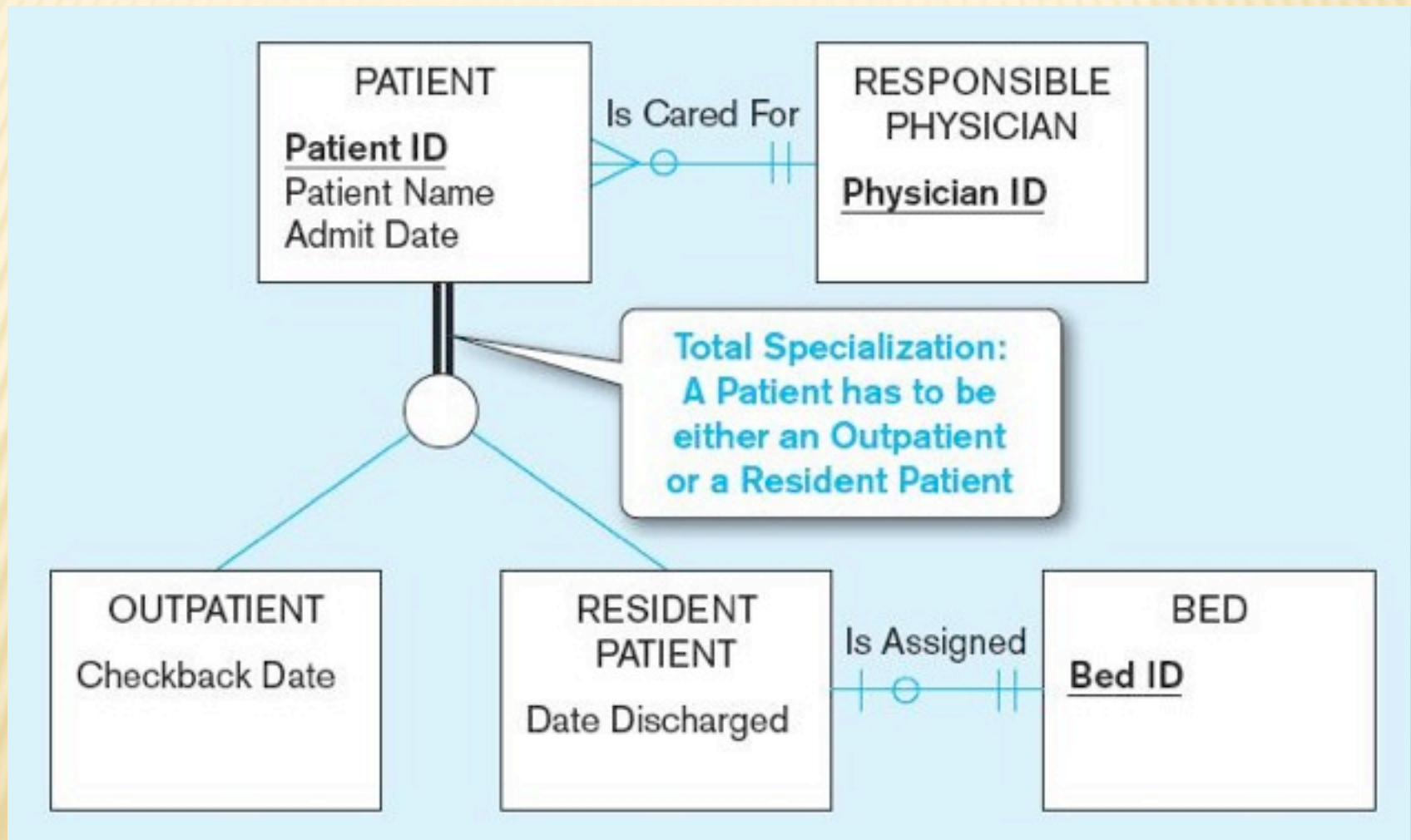
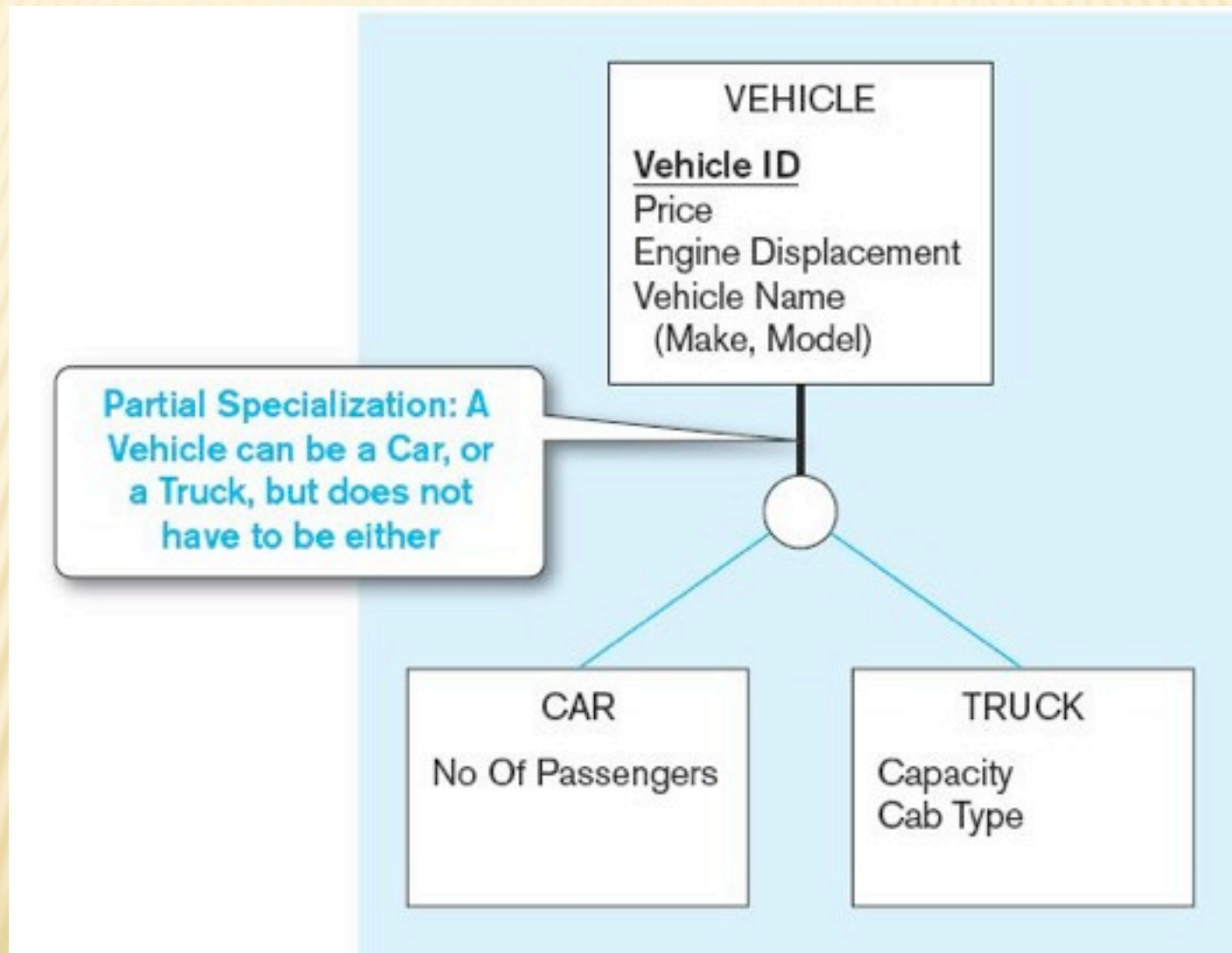


Figure 3-6 Examples of completeness constraints (cont.)

b) Partial specialization rule



CONSTRAINTS IN SUPERTYPE/ SUBTYPE RELATIONSHIPS

✖ **Disjointness Constraints:**

Whether an instance of a supertype may simultaneously be a member of two (or more) subtypes

- + Disjoint Rule: An instance of the supertype can be only ONE of the subtypes

- + Overlap Rule: An instance of the

Figure 3-7 Examples of disjointness constraints

a) Disjoint rule

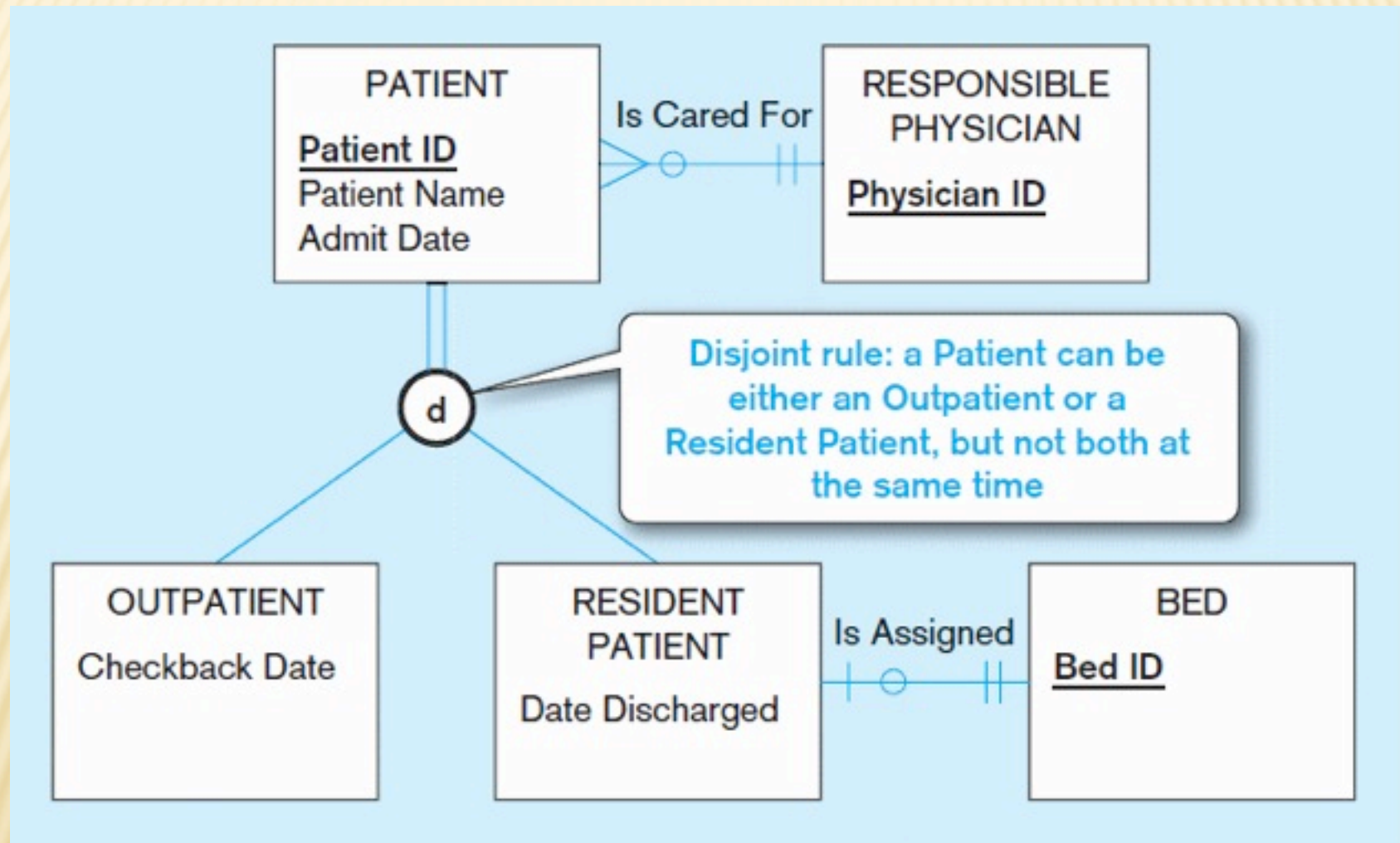
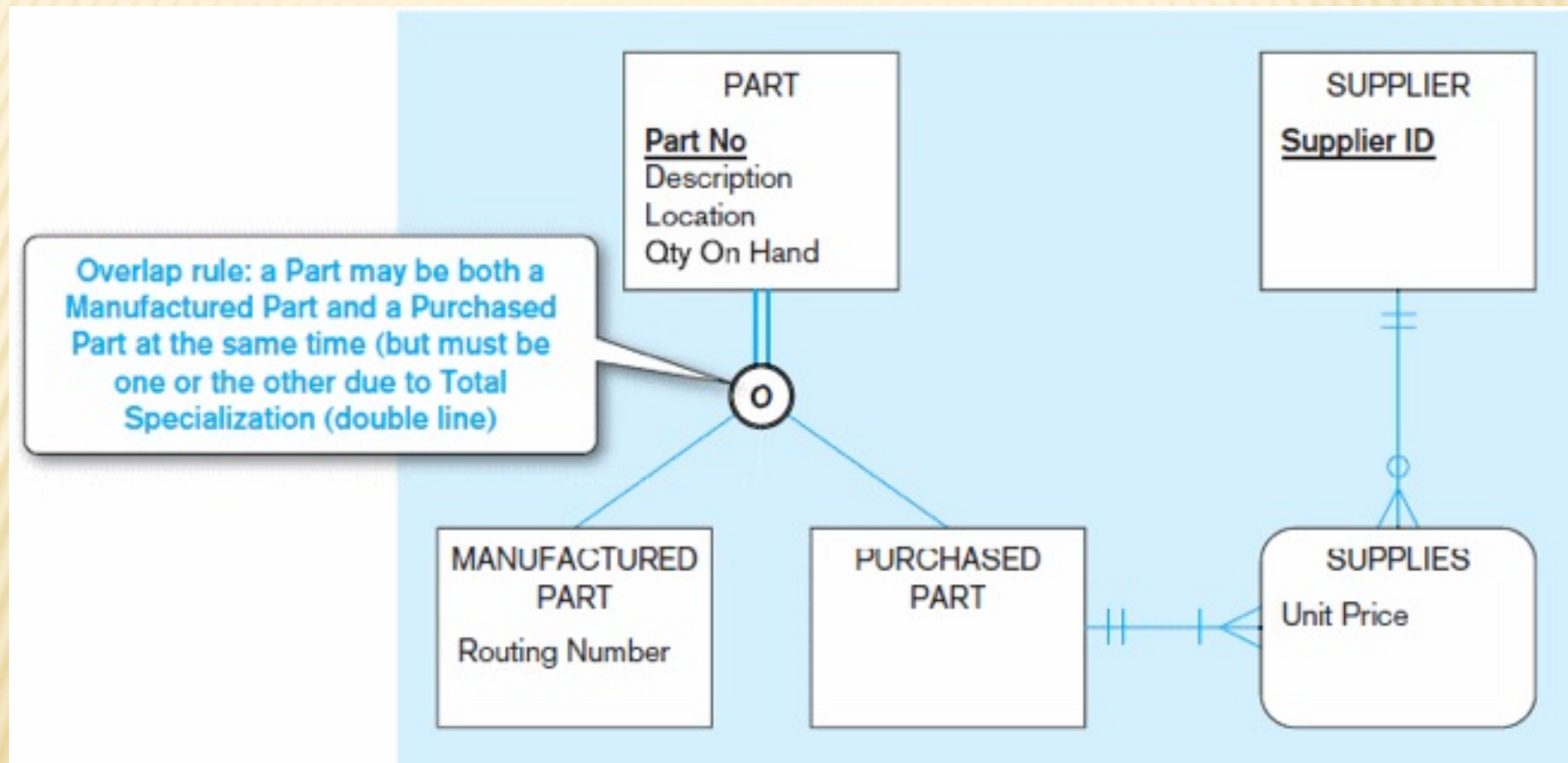


Figure 3-7 Examples of disjointness constraints (cont.)

b) Overlap rule



CONSTRAINTS IN SUPERTYPE/ SUBTYPE RELATIONSHIPS

- ✗ **Subtype Discriminator:** An attribute of the supertype whose values determine the target subtype(s)
 - + **Disjoint** – a simple attribute with alternative values to indicate the possible subtypes
 - + **Overlapping** – a composite attribute whose subparts pertain to different subtypes. Each subpart contains a Boolean value to indicate whether or not the instance belongs to the associated subtype

Figure 3-8 Introducing a subtype discriminator (***disjoint*** rule)

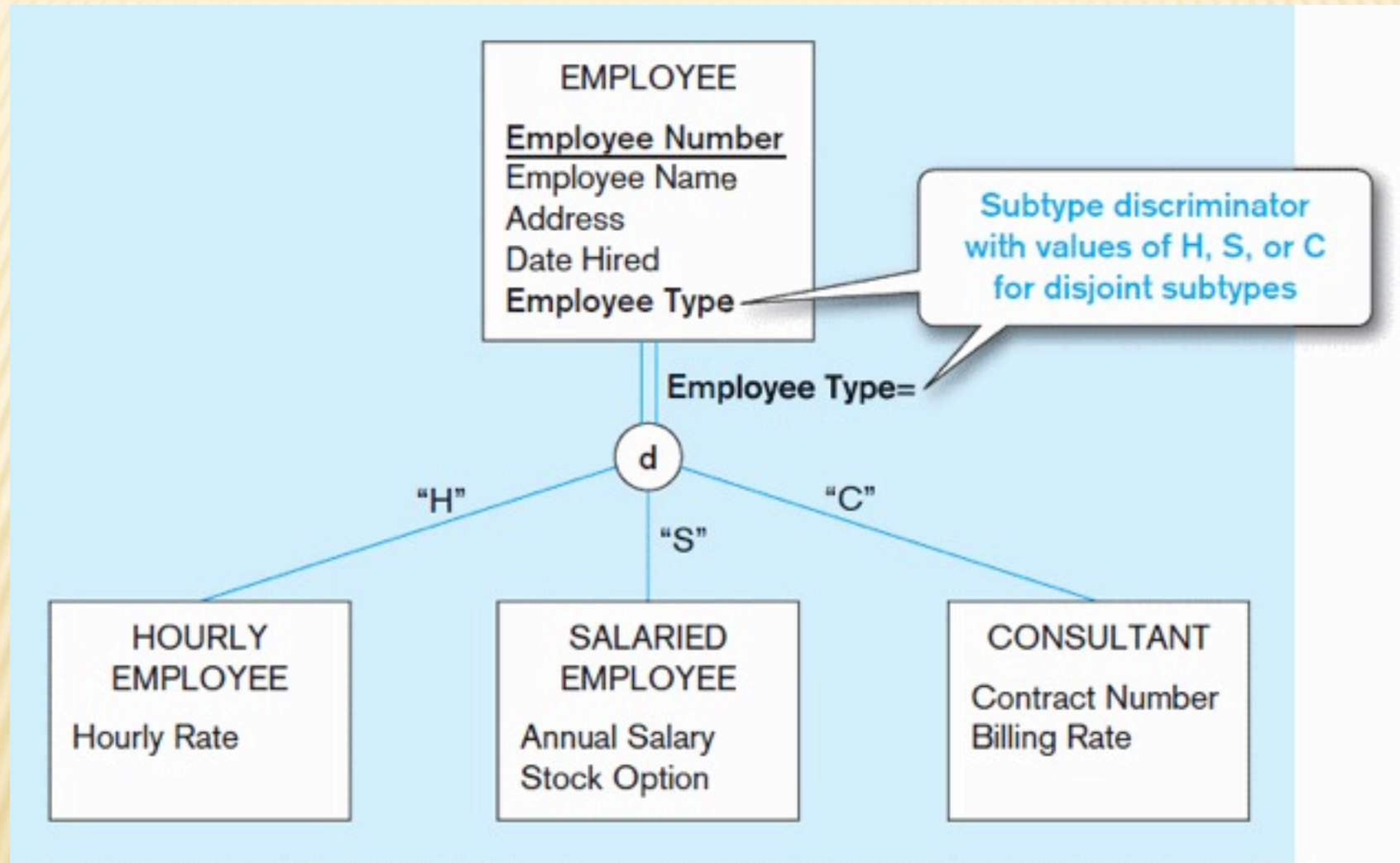


Figure 3-9 Subtype discriminator (**overlap** rule)

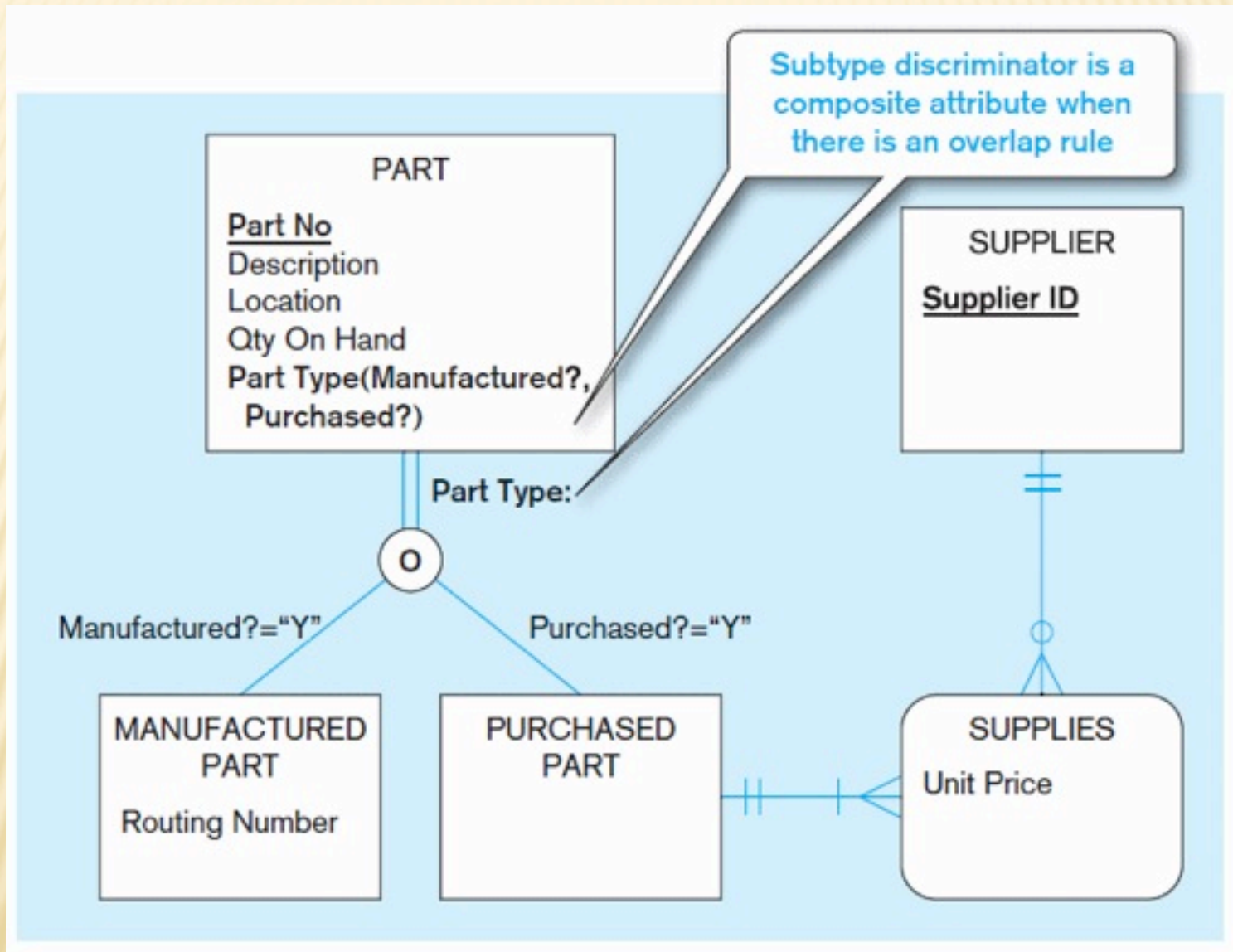
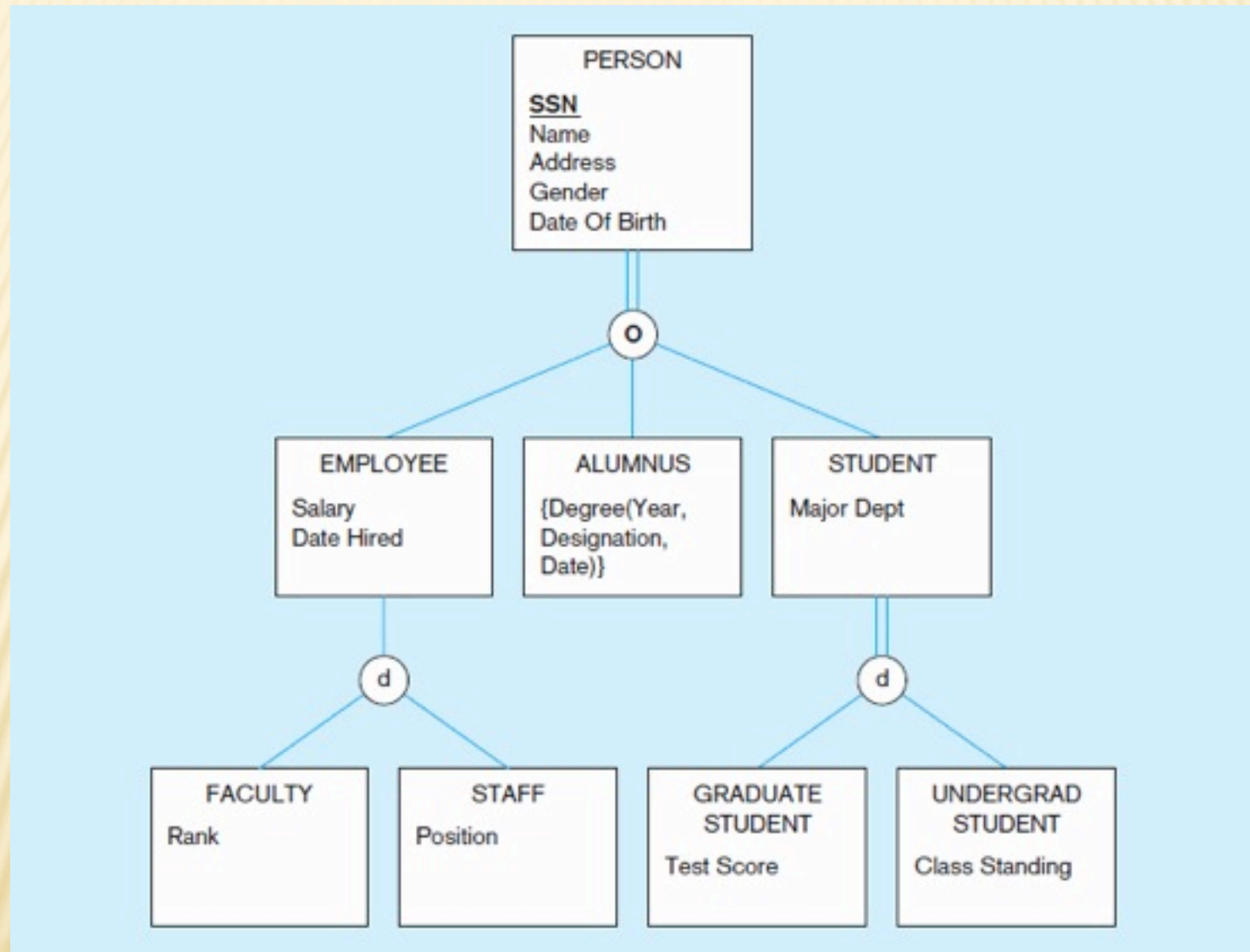


Figure 3-10 Example of supertype/subtype hierarchy



ENTITY CLUSTERS

- ✗ EER diagrams are difficult to read when there are too many entities and relationships.
- ✗ Solution: Group entities and relationships into **entity clusters**.
- ✗ **Entity cluster**: Set of one or more entity types and associated relationships grouped into a single **abstract entity type**

Figure 3-13a
Possible entity clusters for Pine Valley Furniture in Microsoft Visio

Related groups of entities could become clusters

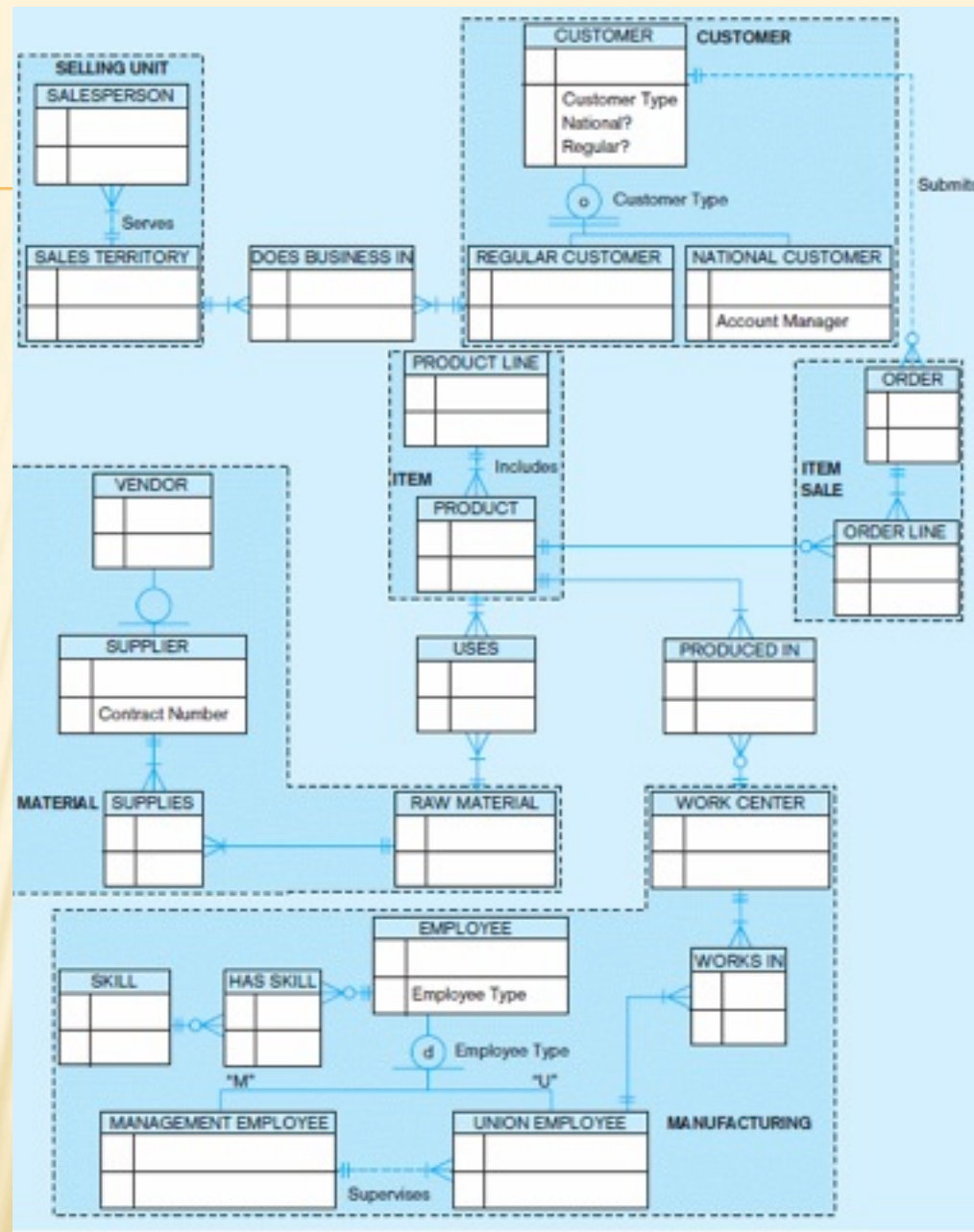


Figure 3-13b EER diagram of PVF entity clusters

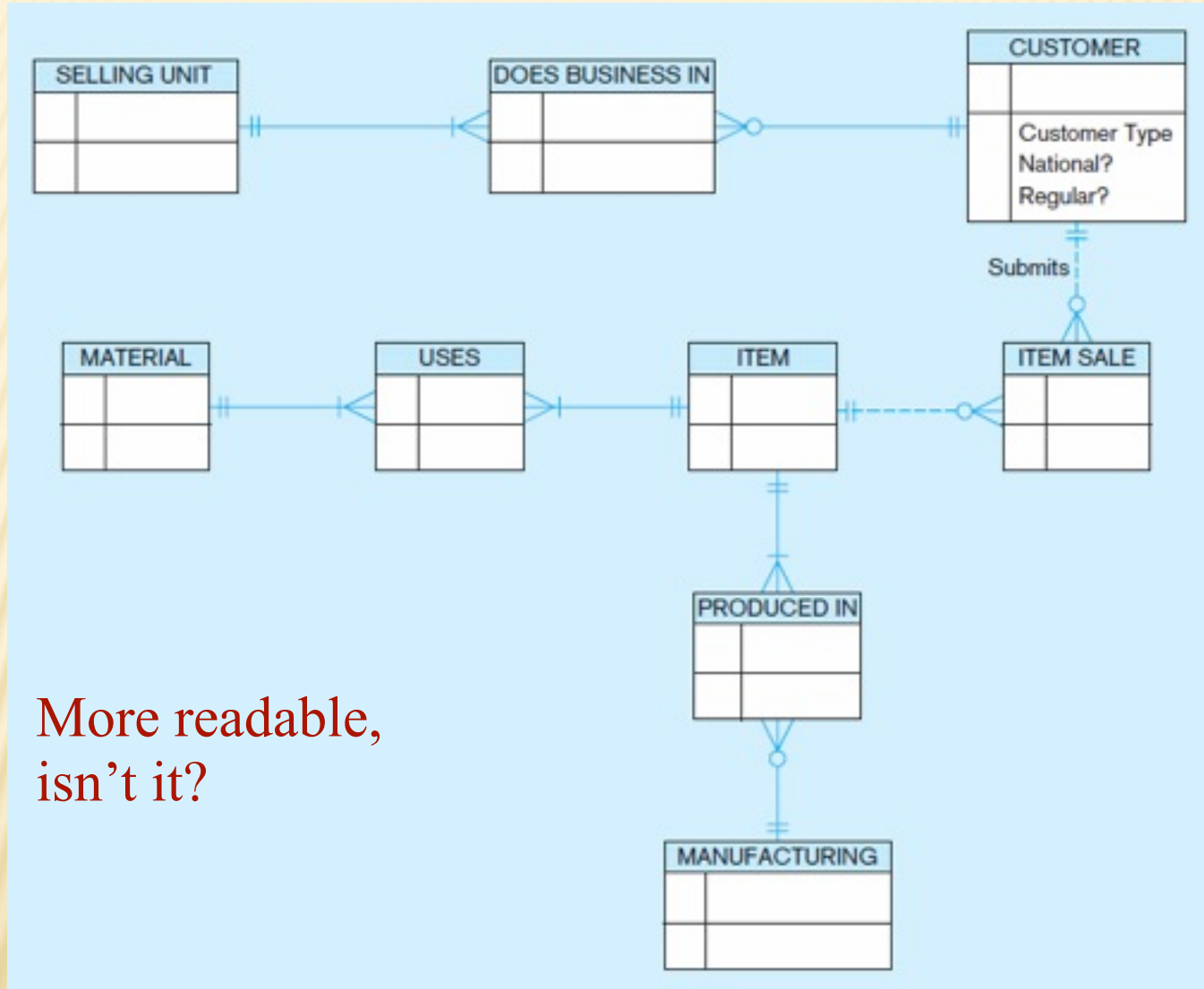
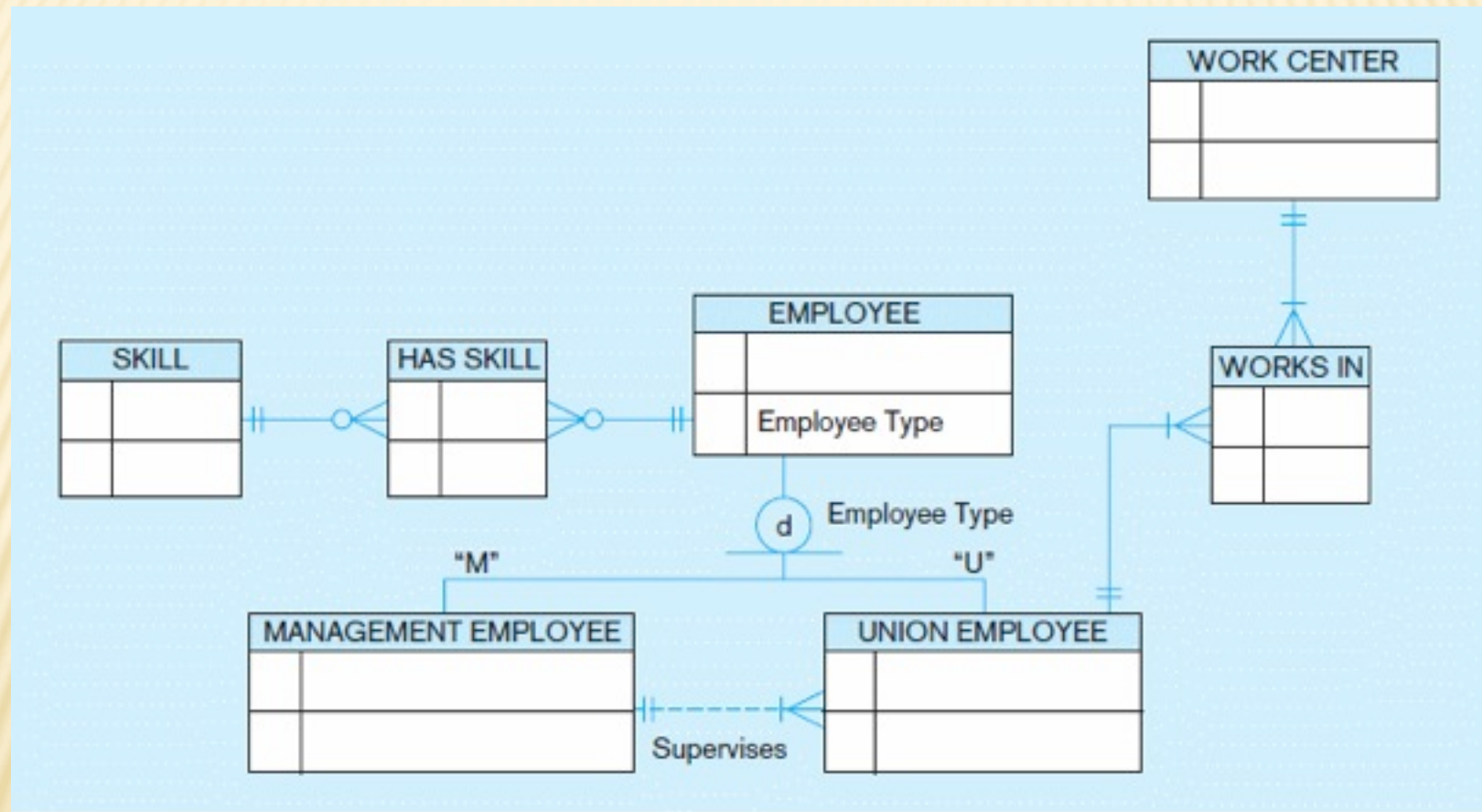


Figure 3-14 Manufacturing entity cluster



Detail for a single cluster

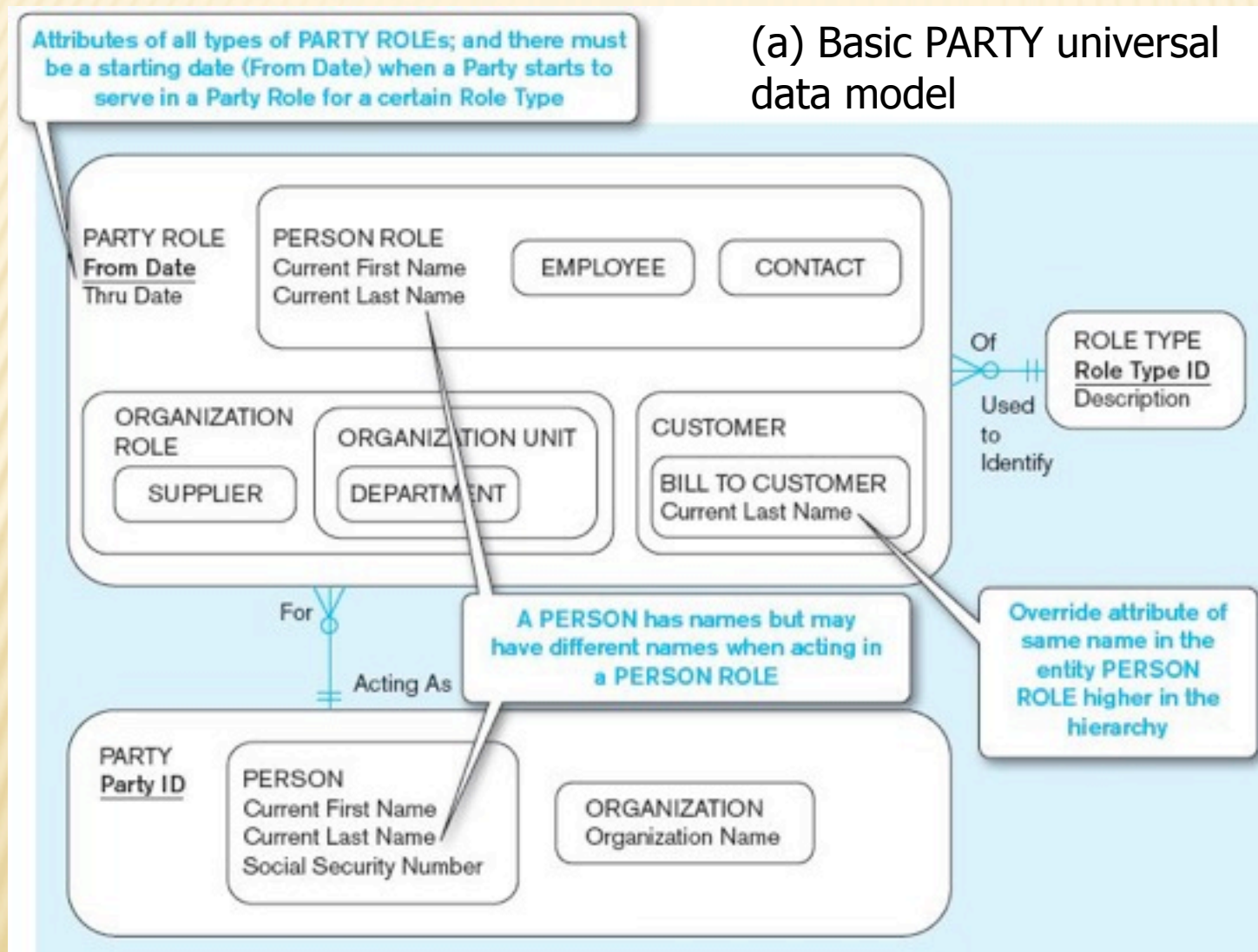
PACKAGED DATA MODELS

- ✖ Predefined data models
- ✖ Could be universal or industry-specific
- ✖ Universal data model = a generic or template data model that can be reused as a starting point for a data modeling project (also called a

ADVANTAGES OF PACKAGED DATA MODELS

- ✗ Use proven model components
- ✗ Save time and cost
- ✗ Less likelihood of data model errors
- ✗ Easier to evolve and modify over time
- ✗ Aid in requirements determination
- ✗ Easier to read
- ✗ Supertype/subtype hierarchies promote reuse
- ✗ Many-to-many relationships enhance model flexibility
- ✗ Vendor-supplied data model fosters integration with vendor's applications
- ✗ Universal models support inter-organizational systems

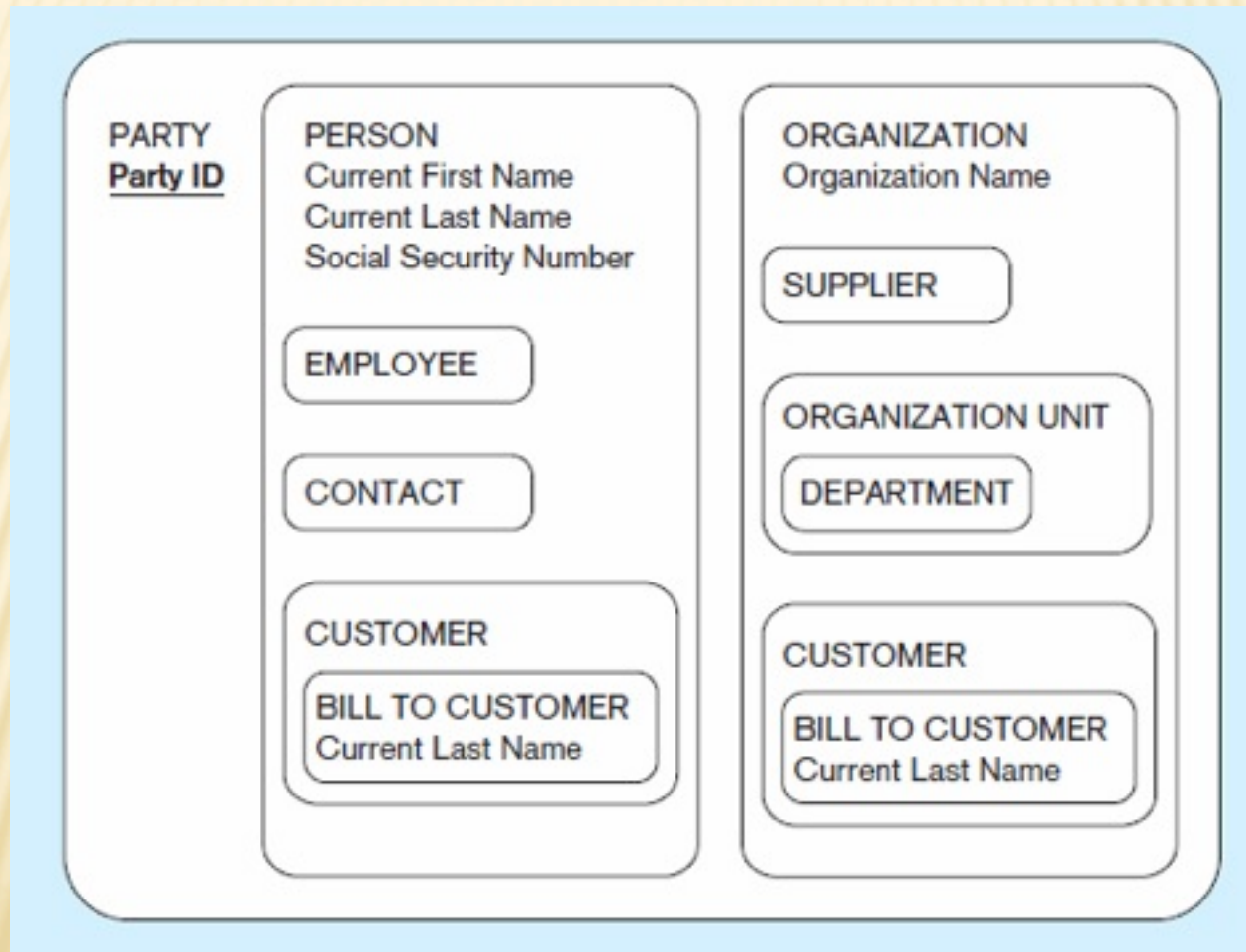
Figure 3-15 PARTY, PARTY ROLE, and ROLE TYPE in a universal data model



Packaged data models are generic models that can be customized for a particular organization's business rules.

Figure 3-15 PARTY, PARTY ROLE, and ROLE TYPE in a universal data model

(b) PARTY supertype/subtype hierarchy





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